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INTERIOR INSPECTION SCAFFOLDING FOR TANK
[Tanku yo naibu tenken ashiba]

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[Claim(s)] /2*

[Claim 1] A scaffolding for inspecting the interior of a tank characterized by comprising: an elevating frame which is fixed separably in the center with at least three expansion arms arranged symmetrically and radially, and moreover, these aforesaid expansion arms are arranged rotatably,
scaffolding stages mounted at the tips of the aforesaid expansion arms,
at least three pairs of elevation suspending means for extending elevatably the aforesaid elevating frames,
guide wheels provided at the tips of the aforesaid expansion arms, and
revolving driving means for the arms which are arranged at least radially as mentioned above.

[Claim 2] The scaffolding for inspecting the interior of a tank of Claim 1 wherein the aforesaid guide wheels are normally energized outwards in the radial direction by springs.

[Claim 3] The scaffolding for inspecting the interior of a tank of Claim 1 or 2 wherein turning means facing the aforesaid guide wheels in the horizontal and vertical directions are arranged on the aforesaid guide wheels.

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*Claim and paragraph numbers correspond to those in the foreign text.

[Detailed Specifications]

[0001]

[Field of Industrial Application] The present invention relates to a scaffolding for inspecting the interior of a tank which stores municipal gas, LPG, etc.

[0002]

[Prior Art] It is necessary to periodically inspect the interiors of tanks that store municipal gas, LPG, and the like as well as grapple with temporary scaffolding for inspecting the interiors thereof. As shown in Figure 5, an internal revolving-type ladder device for a tank described in the publication of Jitsuko No. 43-7463 has been proposed for a conventional inspection scaffolding. But as shown in the drawing, a rail 51 is provided in the inside equatorial part of a spherical tank 50, and a nearly semicircular arcuate ladder main body 52 having an axial core at the vertex of the spherical tank 50 is loaded on the aforesaid rail 51 and then arranged revolvably inside the spherical tank 50 by means of a drive device.

[0003]

[Problems to be Solved by the Invention] However, the internally revolving-type ladder device for a tank described in the above publication has a problem because the structure is a truss structure and it is large in scale. In addition, an inspection work floor 53 was provided in a step-like manner at a fixed height on the ladder

main body 52; hence, there was a problem because a tank's interior could not be inspected from a respective work floor, and it took time and labor to inspect a place a ways off from the level the work floor was at. A worker needed to move up or down to each part of the tank for the inspection work, and there was a problem because it took time for him/her to move. The present invention was accomplished in view of such circumstances. Therefore, it is an object to provide a scaffolding for inspecting the interior of a tank that may be used even for a plurality of tanks without requiring a worker to move it up or down by himself/herself.

[0004]

[Means for Solving the Problems] The scaffolding for inspecting the interior of a tank of Claim 1 suited to the aforesaid object comprises: an elevating frame which is fixed separably in the center with at least three expansion arms arranged symmetrically and radially, and moreover, these aforesaid expansion arms are arranged rotatably, scaffolding stages mounted at the tips of the aforesaid expansion arms, at least three pairs of elevation suspending means for extending elevatably the aforesaid elevating frames, guide wheels provided at the tips of the aforesaid expansion arms, and revolving driving means for the arms which are arranged at least radially as mentioned above. In addition, the aforesaid revolving driving means includes a means which is attached to the center of the elevating frame and has a structure for providing the expansion arms with

rotational torque, or a means for driving the guide wheels attached to the leading ends of the expansion arms and revolving the elevating frames. The scaffolding for inspecting the interior of a tank of Claim 2 is the scaffolding for inspecting the interior of a tank of Claim 1 wherein the aforesaid guide wheels are normally energized outwards in the radial direction by springs. And the scaffolding for inspecting the interior of a tank of Claim 3 is the scaffolding for inspecting the interior of a tank of Claim 1 or 2 wherein turning means facing the aforesaid guide wheels in the horizontal and vertical directions are arranged on the aforesaid guide wheels.

[0005]

[Effects] The scaffoldings for inspecting the interior of a tank of Claims 1 to 3 have guide wheels attached to the leading ends of the elevating arms fixed separably in the centers of at least three expansion arms arranged symmetrically and are elevated by at least three pairs of elevation suspending means; hence, when the tank is a spherical tank, the expansion arms can be elevated while contracting them along the inside surface of this spherical tank even when they are higher than the equatorial part. Thus, the scaffolding stage attached to the tips of the expansion arms can be maintained at any given height. Moreover, when determining the lengths of these expansion arms when they are lower than the equatorial part, the guide wheels at the tips of the expansion arms abut against the inside of the spherical tank and tilting or the like of the elevating

frames is prevented since the positions thereof are determined upon being suspended further by the three pairs of elevating suspending means. Revolving of the elevating frames can be performed by actuating the revolving driving means to rotate the expansion arms. Accordingly, the state of the scaffolding can be arranged at any given position inside the tank. In particular, with the scaffolding for inspecting the interior of a tank of Claim 2, the guide wheels are normally energized in the radial direction of the springs; hence, when the elevating frame is elevated, tilting of the aforesaid elevating frame corresponding directly to the expansion lengths of the expansions arms that differ in a narrow range can be prevented. With the scaffolding for inspecting the interior of a tank of Claim 3, since turning means facing the guide wheels horizontally and vertically are provided, the expansion arms can be guided when a wheel is moving up and down and revolvingly moving.

[0006]

[Practical Examples] To provide an understanding of the present invention, the practical examples embodying the present invention are described next while referring to the appended drawings. Here, Figure 1 is a side view of the scaffolding for inspecting the interior of a tank pertaining to a practical example of the present invention; Figure 2 is a plane view thereof; Figure 3 is a cross section along view A-A in Figure 2; and Figure 4 is a partially enlarged drawing of

the scaffolding for inspecting the interior of a tank pertaining to another practical example.

[0007] As shown in Figures 1 and 2, a scaffolding for inspecting the interior of a tank 10 pertaining to a practical example of the present invention comprises an elevating frame 15 which is provided with three expansion arms 12 to 14 arranged inside a spherical tank 11, an elevating suspending means 16 for the elevating frame 15, scaffolding stages 17 to 19 (called gondolas) which are provided at the tips of the aforesaid expansion arms 12 to 14, guide wheels 20 to 22 attached to the tips of the aforesaid expansion arms 12 to 14, and a revolving driving means 23 arranged in the center of the aforesaid elevating frame 15. These parts will now be described in detail.

[0008] The aforesaid expansion arms 12 to 14 are provided with a multistage hydraulic cylinder A, as shown in Figure 3, and comprise cross-sectional square guide rods 24 to 26 that are mounted in a telescoping manner around the circumferences thereof so that all of the arms expand/contract by expanding/contracting the aforesaid hydraulic cylinder A. The scaffolding stages 17 to 19 having a span wherein a person can get on and work are loaded respectively at the tips of the aforesaid expansion arms 12 to 14. Here, since the aforesaid guide rods 24 to 26 have cross-sectional square shapes, the scaffolding stages 17 to 19 loaded at the tips maintain a horizontal state, and have a structure where they are fixed to the tips of the expansion arms 12 to 14.

[0009] The aforesaid three expansion arms 12 to 14 are attached radially to a center revolving stage 27 separably in increments of 120 degrees. A fixed stage 15a is provided in the upper or lower portion of the revolving stage 27 and the revolving stage 27 is attached rotatably to this fixed stage 15a. The expansion arms 12 to 14 are rotated slowly by means of a decelerating motor 15b attached to the upper part of the fixed stage 15a or by driving the guide wheels 20 to 22 at the leading ends of the expansion arms 12 to 14.

[0010] Although the guide wheels 20 to 22 are attached respectively to the tips of the aforesaid expansion arms 12 to 14, these guide wheels 20 to 22 are composed of vertical wheels 20a to 22a and horizontal wheels 20b and 22b (22b is not illustrated), and respective advancing/retreating mechanisms are provided at the aforesaid horizontal wheels 20b and 22b to abut against the inside of the spherical tank 11 in a retreating position (other than when the aforesaid elevating frame 15 is revolving horizontally). The aforesaid advancing/retreating mechanisms may be composed of hydraulic cylinders, or they may be operated by a handle or drive source operation utilizing link mechanisms, cam mechanisms, etc. The horizontal wheels 20b and 22b should move forward or backwards a prescribed distance.

[0011] In addition, as shown in Figure 4, a wheel 28 is held to freely rotate as the aforesaid guide wheel. A rotary actuator 29 is attached to its rear and is turned 90 degrees hydraulically or

manually. Depending on the purpose, it can function as a horizontal wheel or a vertical wheel. Accordingly, a more compact device can be engineered. Preferably, the aforesaid guide wheels 20 to 22 are attached elastically via springs, etc. Accordingly, expansion/contraction of the expansion arms 12 to 14 can be mitigated in accordance with the elevation of the aforesaid elevating frame 15.

[0012] The aforesaid elevating suspending means 16 comprises six winches 35 and are attached to the ceiling portion or lower part of the spherical tank 11. The leading end of a wound up wire rope 36 is attached symmetrically to the aforesaid fixed stage 15a. By synchronously rotating the aforesaid six winches 35, the elevating frame 15 is elevated. Moreover, the synchronous rotation of the aforesaid six winches 35 can be performed mechanically or electrically.

[0013] As a consequence, when this scaffolding for inspecting the interior of a tank 10 is used, attachment fittings for the winches 35 are attached to the inside of the spherical tank 11. Other machinery that are dismantled and stored can be transported into and assembled, when needed, in the spherical tank 11 through a manhole 37 provided in the spherical tank 11. When this scaffolding for inspecting the interior of a tank 10 is moved vertically, the vertical wheels 20a to 22a abut against the inside of the spherical tank 11 to gradually expand/contract the expansion arms 12 to 14 and operate the six winches 35 so as to tension the wire rope 36.

[0014] Next, in order for the scaffolding stages 17 to 19 to revolve, and so that only the horizontal wheels 20b and 22b abut against or are brought close to the inside of the spherical tank 11, the expansion arms 12 to 14 are revolved by means of the aforesaid decelerating motor 15b or by driving the horizontal wheels 20b and 22b at the leading ends of the expansion arms 12 to 14, and thus, the scaffolding stages 17 to 19 can be arranged in the prescribed positions.

[0015] In addition, although there were three expansion arms in the aforesaid practical example, four or more of them can be provided.

[0016]

[Advantages of the Invention] As understood from the description above, the scaffolding for inspecting the interior of a tank of Claims 1 to 3, the position of each of the scaffolding stages could be set to any given position in the vertical direction, and these stages could be moved when workers were riding thereon; hence, the workability was improved all the more. Since the entire piece of equipment is constructed simpler than a conventional piece of equipment, a plurality of tanks can be supported simply by configuring the equipment so that it can be separated.

[Brief Description of the Drawings]

[Figure 1] A side view of the scaffolding for inspecting the interior of a tank pertaining to a practical example of the present invention.

[Figure 2] A plane view of the same.

[Figure 3] A cross section along view A-A in Figure 2.

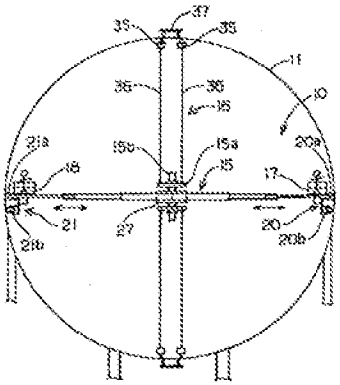
[Figure 4] A partial enlarged diagram of the scaffolding for inspecting the interior of a tank pertaining to another practical example.

[Figure 5] A schematic diagram of a scaffolding for inspecting the interior of a tank pertaining to a conventional example.

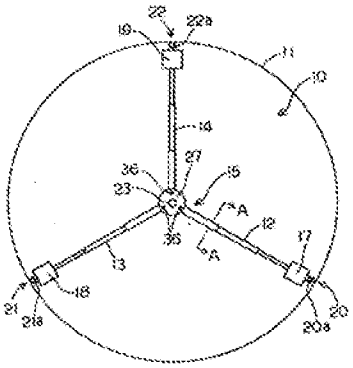
[Explanation of the Reference Numerals]

10: scaffolding for inspecting the interior of a tank; 11: spherical tank; 12: pump intake side passage; 13: expansion arm; 14: expansion arm; 15: elevating frame; 15a: fixed stage; 15b: decelerating motor; 16: elevating suspending means; 17: scaffolding stage; 18: scaffolding stage; 19: scaffolding state; 20: guide wheel; 20a: vertical wheel; 20b: horizontal wheel; 21: guide wheel; 21a: vertical wheel; 21b: horizontal wheel; 22: guide wheel; 22a: vertical wheel; 22b: horizontal wheel; 23: revolving driving means; 24: guide rod; 25: guide rod; 26: guide rod; 27: revolving stage; 28: wheel; 29: rotary actuator; 35: winch; 36: wire rope; 37: manhole; A: pneumatic cylinder

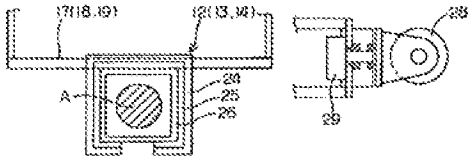
[Figure 1] [Figure 2]



[Figure 3]



[Figure 4]



[Figure 5]